

Original Communication

Determining prognosis after spinal cord injury

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Abstract

Introduction: Disability following traumatic spine injury often requires assessment for judicial reasons.

Objective: To determine the optimum time to carry out a medico-legal evaluation.

Methods: Retrospective study (1995–2000) of patients with traumatic spine injury with a follow-up of five years. The American Spinal Injury Association (ASIA) scale was used to determine level and extent of the injury. Statistical analysis by SPSS 11.0.

Results and discussion: 173 injuries were analyzed (39.3% ASIA A; 15.6% ASIA B; 29.47% ASIA C; 15.6% ASIA D). Neurological improvement was detected in 35.83%, more frequently in incomplete injuries. ASIA A injuries remained mainly complete from admission to discharge and in no case reached functional levels. Only a third of ASIA B patients showed improvement, of whom 33.3% were functional. Improvement in ASIA C patients was 76.4%, these and all ASIA D patients were functional on discharge. The condition a year after the injury remained unchanged in all cases, regardless of the extent of injury. Patients who showed improvement did so early on, mainly during hospitalization.

Conclusions: The optimum time for evaluation of spinal cord injury for medicolegal purposes is at one year after the injury. In cases of complete injury, evaluation can be carried out on discharge with no need to wait for one year.

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Keywords: Posttraumatic spinal cord injury; Neurological improvement; Sequelae; Medico-legal assessment

1. Introduction

Post-traumatic spinal cord injury gives rise to varying degrees of disability which is frequently the object of judicial assessment. This impairment is typically significant and crippling. Epidemiological studies show that spinal cord injury (SCI) usually affects young people,^{1–3} thus occurring at the beginning of the period of highest financial productivity.⁴ Treatment in specialized units is expensive, and initial hospitalization costs in excess of 150,000 € can be expected.⁵ Home modification costs can rise to over 6000 €. The cost of personal assistance and institu-

tional care after discharge average 4762 € per year.⁶ Moreover, life expectancy, taking all kinds of spinal injuries into account, is only 15% less than that of the normal population.⁷ The cost of care of the patient after discharge and sequelae are disputed in legal cases which arrange a settlement, using AMA guides to evaluate permanent impairment and specific Spanish legislation (RDL 8/2004 and RD 1971/1999) in order to translate impairment to disability, and disability to economical compensation.⁸ In short, the actual monetary cost of SCI is enormous, and judicial assessment is required to achieve an optimal evaluation as soon as the injury has stabilized. There are two main reasons why a precise definition of the period of consolidation is important: firstly, the amount of the settlement can be determined from the sequelae, and sec-

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ondly, the shorter the period of consolidation, the lower the economic benefit.

The aim of this study is to monitor the progress of the injury after hospital discharge in order to determine the best time to carry out a medico-legal evaluation of the sequelae.

2. Materials and methods

An international classifying system, ASIA⁹ (American Spinal Injury Association) scale, is used to determine the level and extent of the injury. Imaging studies are not used in establishing the ASIA grade, which is a purely physical examination. After a motor and sensory examination, the neurological level of injury can be determined and the degree of completeness can be specified. According to the ASIA scale, the neurological level is defined as the segment just below the most cranial abnormal segment on both sides of the body (Fig. 1a). Extension of injury is defined by the recommendations of ASIA (Fig. 1b).

A retrospective study of patients admitted to the Galician Spinal Cord Injury Unit (NW of Spain) with acute post traumatic spinal cord injury was made between 1995 and 2000 with a minimum full follow-up of five years. This unit admits all acute traumatic spinal cord injuries irrespective of the severity of the injury. All patients who had

undergone the annual checkups were included in a data base for statistical analysis using SPSS 11.0. Twenty-two patients classified as ASIA grade E on admission were excluded. No other exclusion criteria was applied.

3. Results

No injuries resulting from penetrating or blast trauma were recorded, and no patients were lost or died during the study. A total of 173 patients were analyzed and the distribution of patients following the ASIA scale was: 68 (39.3%) ASIA A; 27 (15.6%) ASIA B; 51 (29.47%) ASIA C and 27 (15.6%) ASIA D. Neurological improvement was detected in 35.83% of patients, more frequently in incomplete injuries (6% of ASIA A, 63% of ASIA B and 76.4% of ASIA C). The amount of neurological recovery seems to be inversely proportional to the severity of the initial examination. No cases of neurological deterioration were reported and all results are given in Fig. 2.

Ninety four percent of injuries classified as ASIA A remained complete from admission to discharge. Any improvements occurred early on, and in no case reached functional levels.

Only a third of ASIA B patients showed improvement, of whom 33.3% were functional. Neurological improvement in ASIA C patients was 76.4%, all of whom were

STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

MOTOR

KEY MUSCLES

	R	L
C2		
C3		
C4		
C5		
C6		
C7		
C8		
T1		
T2		
T3		
T4		
T5		
T6		
T7		
T8		
T9		
T10		
T11		
T12		
L1		
L2		
L3		
L4		
L5		
S1		
S2		
S3		
S4-5		

Elbow flexors
Wrist extensors
Elbow extensors
Finger flexors (distal phalanx of middle finger)
Finger abductors (little finger)

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
NT = not testable

Hip flexors
Knee extensors
Ankle dorsiflexors
Long toe extensors
Ankle plantar flexors

Voluntary anal contraction (Yes/No) ☐

TOTALS ☐ + ☐ = ☐ **MOTOR SCORE**
(MAXIMUM) (50) (50) (100)

LIGHT TOUCH PIN PRICK

	R	L	R	L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

0 = absent
1 = impaired
2 = normal
NT = not testable

Any anal sensation (Yes/No) ☐

TOTALS ☐ + ☐ = ☐ **PIN PRICK SCORE** (max: 112)
(MAXIMUM) (56) (56) (56) (56)

☐ + ☐ = ☐ **LIGHT TOUCH SCORE** (max: 112)

NEUROLOGICAL LEVEL

The most caudal segment with normal function

SENSORY ☐ R ☐ L

MOTOR ☐ R ☐ L

COMPLETE OR INCOMPLETE?

Incomplete = Any sensory or motor function in S4-S5

☐ COMPLETE ☐ INCOMPLETE

ASIA IMPAIRMENT SCALE

ZONE OF PARTIAL PRESERVATION

Partially innervated segments

SENSORY ☐ R ☐ L

MOTOR ☐ R ☐ L

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Fig. 1a. ASIA impairment scale for level.

ASIA Impairment Scale for Completeness

- A: Complete; no sensory or motor function in the sacral segments S4–S5
- B: Incomplete; sensory but not motor function is preserved below the neurologic level and includes sacral segments S4–S5.
- C: Incomplete; motor function is preserved below the neurologic level, and more than half of the key muscles below the neurologic level have a muscle grade less than 3
- D: Incomplete; motor function is preserved below the neurologic level, and at least half of key muscles below the neurologic level have a muscle grade greater than or equal to 3
- E: Normal; sensory and motor function are normal

ASIA, American Spinal Injury Association.

Modified from the Frankel scale with permission from the American Spinal Injury Association. *International standards for neurological and functional classification of spinal cord injury*. Chicago: American Spinal Injury Association, 1996.

Fig. 1b. ASIA impairment scale for extension.

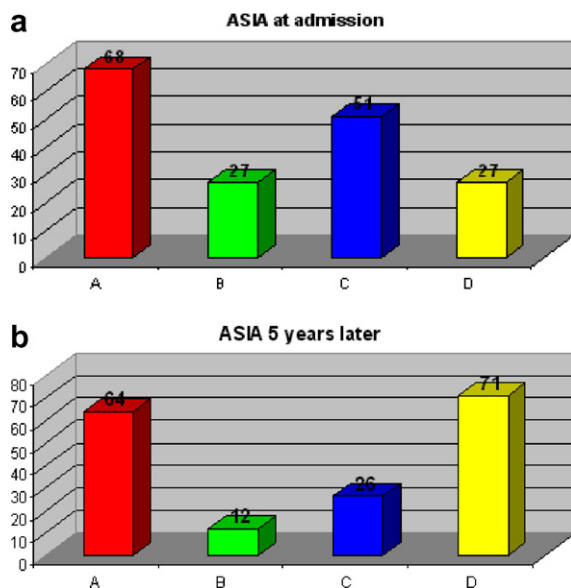


Fig. 2. Neurological improvement according to extension: 2(a) at admission; 2(b) five years later.

functional and all ASIA D patients were functional on discharge.

Only two ASIA C patients showed neurological recovery after the first year. In spite of this exception, the condition a year after the injury remained unchanged in all cases, regardless of the extent of injury. We found no statistical differences between the first and fifth year after discharge ($p > 0.05$). Those patients who showed improvement did so early on, mainly during hospitalization. Of the total number of cases showing improvement, 14.45% were recorded during the time between discharge and a year on from the date of the injury. Associated lesions were

found in 69.3% of cases, but there was no statistical significance between these patients and those with non-associated lesions.

4. Discussion

No cases of traumatic or blast trauma were found in our study, probably due to the absence of injuries resulting from gunshot or stab wounds and other acts of violence. Penetrating spinal cord injury fluctuates from 1.3% in Spain³ to 2% in Denmark¹⁰ to 29.5% in USA⁵ depending on the country and author consulted.

Previous studies on post traumatic spinal cord injury agree that neurological improvement usually begins early on.¹¹ Some authors state that complete injuries show no further improvement in either level or extent, after the first year, whereas, incomplete injuries may take two years to become stabilized.¹² Prognoses for ambulation in ASIA A injuries in previous reports are in agreement with our results and the percentage of ASIA C patients reaching functionality is similar to other authors.¹³ According to our study, stabilization of the extent of spinal injury takes place during the first year irrespective of its degree of completeness. The time period needed to determine if a patient will make significant neurological improvement is one year after injury. Any recovery appearing after this time will be minimal. It is also reasonable to expect that incomplete injuries improve with greater frequency.¹⁴

The possibility of improvement in ASIA C patients with a favourable neurological examination (close to ASIA D) a year after injury is rare, but they can exceptionally reach ASIA D in the first two years. This potential for slight recovery must be considered in assessment, and is the only reason that might delay medico-legal assessment.

The reason for the lack of influence of associated lesions on the consolidation of spinal cord injury may be due to the fact that their stabilization precedes SCI consolidation, and this latter then follows uninfluenced by other lesions.

5. Conclusions

1. Neurological improvement is more frequent in incomplete injuries.
2. Complete injuries do not attain functional levels (grade D) within the studied period of time.
3. With regard to the extent of the injury, stability is reached within a year. The optimum time for assessment of medulla injury is at one year after the injury.
4. In cases of complete injury, evaluation can be carried out on discharge with no need to wait for one year.

Acknowledgement

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